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NOTICE OF INTERESTING NEW FORMS OF CARBONIFEROUS FISH REMAINS.

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THROUGH the kindness of Professor G. Hambach, of Washington University, St. Louis, a number of highly instructive Carboniferous fish remains have recently been brought to the writer's attention, two of which seem to possess considerable interest, and are therefore made the subject of the following notice. The first to which attention is invited is a remarkable specimen of *Erismacanthus* from the vicinity of St. Louis, now preserved in the private collection of Dr. Hambach. It is unquestionably the largest and at the same time most perfect spine belonging to this genus yet brought to light, and appears to be distinct from other described species. The second specimen noticed in the present paper yields new information regarding the dentition of *Campodus corrugatus*, and is from the Coal Measures of Winchester, Illinois.

Genus *Erismacanthus* M'Coy.

The two European and one American species of this genus that have been described are evidently closely related to *Physonemus*, but differ in that the spines are divaricated, the two branches extending in opposite directions in the same vertical plane. The imperfect ichthyodorulites known as *Gampsacanthus*, *Lecracanthus*, and *Dipriacanthus* are also of the same general nature, and all these bodies are interpreted by most authors as lateral head spines of presumably cochlodont or petalodont sharks. The occurrence of spines on either side of the head in sharks and chimæroids has been observed in a number of forms, such as in *Oracanthus armigerus* Traquair, from the Calciferous sandstone of Eskdale, Scotland, in the Permian *Menaspis armata*, and in Mesozoic cestracionts (*Hybodus*).

The *Physonemus* group of spines has been theoretically associated by Jaekel with the teeth of petalodonts, but this conjecture has not been corroborated as yet by any direct evidence.

Very interesting stages of modification are displayed by the group of *Physonemus*-like spines throughout their existence in the Lower Carboniferous. The earliest and most primitive forms of the typical genus are found in the Kinderhook, in accompaniment with small forms of *Stethacanthus*. The two or more species of Kinderhook *Physonemi* that are known are of small size, attenuated, and quite destitute of surface ornamentation. *Erismacanthus* is also represented in the Kinderhook by two small, comparatively unornamented species, and it is noteworthy that the branched condition is here rudimentary. The Burlington species of *Physonemus* and *Stethacanthus* display a marked increase in size, but the ornamentation is feeble, and remains so throughout the stage represented by the Keokuk Limestone. *Stethacanthus* seems to have attained its maximum size in the Keokuk, as *Physonemus* did in the Burlington (*P. gigas* N. and W.), a considerable falling off in this respect being true of both genera in the St. Louis division. The spines of *Stethacanthus* remain unornamented from their first appearance in the Berea Grit of Ohio until their extinction in the St. Louis Limestone, but those of *Physonemus* and *Erismacanthus* increase in complexity of ornamentation throughout the Mississippian series, ultimately displaying great elaboration. An inspection of the forms illustrated in Plate XXII of the sixth volume of the *Illinois Palæontology*, or of the large spine immediately to be described, will, we think, satisfy any one as to the correctness of this latter statement and of the above generalizations.

***Erismacanthus formosus* sp. nov. (Fig. 1).**

DEFINITION. — A very large species, the spines attaining a total length of at least 22 cm. Anterior branch stout, much produced, gently arched, one side more or less flattened and provided with a double row of obtusely conical denticles, the other smooth and convex, appearing as if imbedded. Posterior spine considerably arched, prominently keeled, laterally compressed, and bearing a double series of closely set denticles along the distal half of the posterior margin. The posterior spine is relatively wide in its

basal portion, and tapers gradually toward the acuminate distal end; its surface is ornamented with numerous longitudinal costæ which increase by bifurcation, and by rows of small, rounded or spiniform tubercles occupying the intercostal spaces, these being especially numerous on the broad basal portion of the spine, and extending also over the proximal portion of the anterior branch.

The above description is based upon the remarkable spine shown in Fig. 1, together with two or three imperfect specimens, all collected by Dr. Hambach from the St. Louis Limestone in the vicinity of St. Louis, Missouri. The large specimen has a total length of 21.5 cm., of which the anterior branch forms about four-sevenths and the posterior spine three-sevenths. It is nearly seven times the size of *E. maccoyanus*

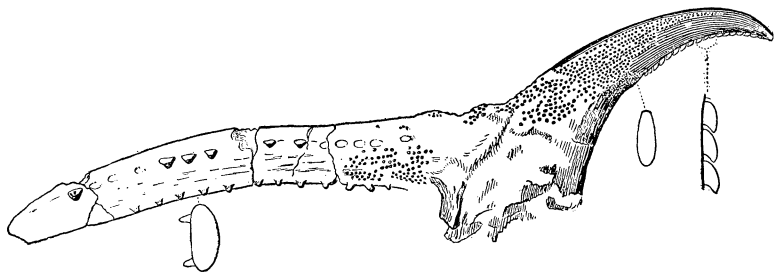


FIG. 1.—*Erismacanthus formosus* sp. nov. St. Louis Limestone; St. Louis, Mo. Lateral aspect of spine referred to the left side of the head, $\times \frac{1}{2}$. Cross sections are given of both branches at the points indicated by dotted lines, and three of the posterior denticles are shown slightly larger than the natural size.

St. J. and W., which accompanies it in the same formation, and twice that of *E. jonesi* M'Coy, the largest known European species. From both of these the present species differs not only in size, but also in the form of cross section and denticulations of the anterior branch, as well as in the general surface ornamentation. It appears improbable that the anterior branch was terminated by a cluster of denticles, but there is a double row of about twenty robust conical enameled bosses along the flattened face of this arm, which have evidently become obtuse through wear. This flattened face was probably entirely exposed, but there is reason to believe that the opposite, or more convex face, was buried in the integument. Its smooth surface presents the same appearance as the inserted portion of most fin spines, and betrays none of the usual indications of wear.

Obviously if this portion of the spine had projected freely, and were not anchored by insertion in the soft parts, it would have been not only a useless appendage but a positive hindrance to the creature, besides being constantly exposed to injury; but if we conceive of it as inserted in the integument in the same manner as the anterior prolongation of *Oracanthus vetustus*,¹ its function as a defensive organ and as a support for the posterior spine is readily understood. Evidence that this was a paired spine, and therefore not occupying a position in the median line of the back or of the head, is afforded by the fact that the exposed face of the anterior branch is turned so as to present the denticles toward the left-hand side; and the organ may therefore be interpreted as a lateral head spine belonging to the left side of the body.

The posterior spine is very similar to the single defenses of *Physonemus*, but is more strongly keeled and broader at the base. The distal half of the posterior margin bears a double row of closely set denticles resembling those of *E. maccoyanus*. The sides of the spine are occupied by numerous fine, smooth longitudinal costæ, of which about fifteen are to be counted along the line where the cross section shown in the figure is taken. The intercostal spaces, more particularly in the basal portion of the spine, are studded with numerous small tubercles, which are stellate in the unworn condition, and vary in shape between conical and spiniform. In many cases their summits are mucronate with the points reflected toward the basal portion of the spine, and the resemblance of these tubercles to certain types of placoid scales is very marked. It is probable that the imperfect spine illustrated in Pl. XXII, Fig. 3, of the sixth volume of the *Illinois Palæontology*, represents a young individual of this species.

Genus *Campodus* de Koninck.

This genus of cestraciont sharks is represented in the Coal Measures of North America by three species, one of which — *C. variabilis* (N. and W.) — is of importance as affording a

¹ Cf. J. S. Newberry, *Trans. N. Y. Acad. Sci.*, vol. xvi (1897), p. 287, Pl. XXII, Fig. 3.

complete insight into the dentition of *Orodus*-like forms. The species described by Newberry and Worthen as *C. corrugatus* has been known hitherto only by a few of the lateral teeth,



FIG. 2. — *Campodus corrugatus* (N. and W.). Coal Measures; Winchester, Ill.
Oral aspect of a portion of the symphyseal dentition, $\times \frac{3}{4}$.

and we have been without information regarding the symphyseal series. One specimen, however, of the symphyseal dentition has recently come to light, and seems worthy of particular description.

Campodus corrugatus (Newberry and Worthen) (Fig. 2).

The symphyssial dentition of this species differs from that of *C. variabilis* in that the individual teeth are much more robust, less intimately fused with one another, and less differentiated in form from the lateral series; they are also apparently fewer in number than in the corresponding series of *C. variabilis*. All these characters point to the conclusion that as between the two species the latter is much more highly specialized and stands nearer to the line which gave off *Edestus* and other extremely modified cestracionts.¹

The unique specimen of *C. corrugatus* shown in Fig. 2 exhibits five very robust teeth, which are recognizable by their peculiar form as having pertained to the symphyssial series. Of how many teeth the entire series was constituted cannot be told, but owing to the large size of the teeth it is probable that the number was less than in *C. variabilis*, which has as many as thirteen. The apical extremities of the crowns have unfortunately all been broken away, and the bilateral symmetry of the series has been disturbed by mechanical agencies since the death of the creature, so that the teeth appear to succeed one another in spiral fashion, instead of being arched in a single plane. The apical portions of the crowns differ from those of *C. variabilis*, also, in that they are more elevated, and are inclined backward at a slight angle.

The coronal surface of each tooth is marked by a prominent transverse crest, from which numerous branches are given off approximately at right angles on either side. The anterior margins of the crowns are very prominently buttressed, an especially large projection occurring in the median line on both the anterior and posterior faces. Fig. 2 is photographed from a cast of the original specimen, which was obtained from Bates and Company's coal mine at Winchester, Illinois.

¹ A detailed account of the dentition of *Edestus* and related forms is given in *Bull. Mus. Comp. Zool.*, vol. xl, No. 3, 1902.